Human Activity Identification

Sinhgad Institutes

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Introduction

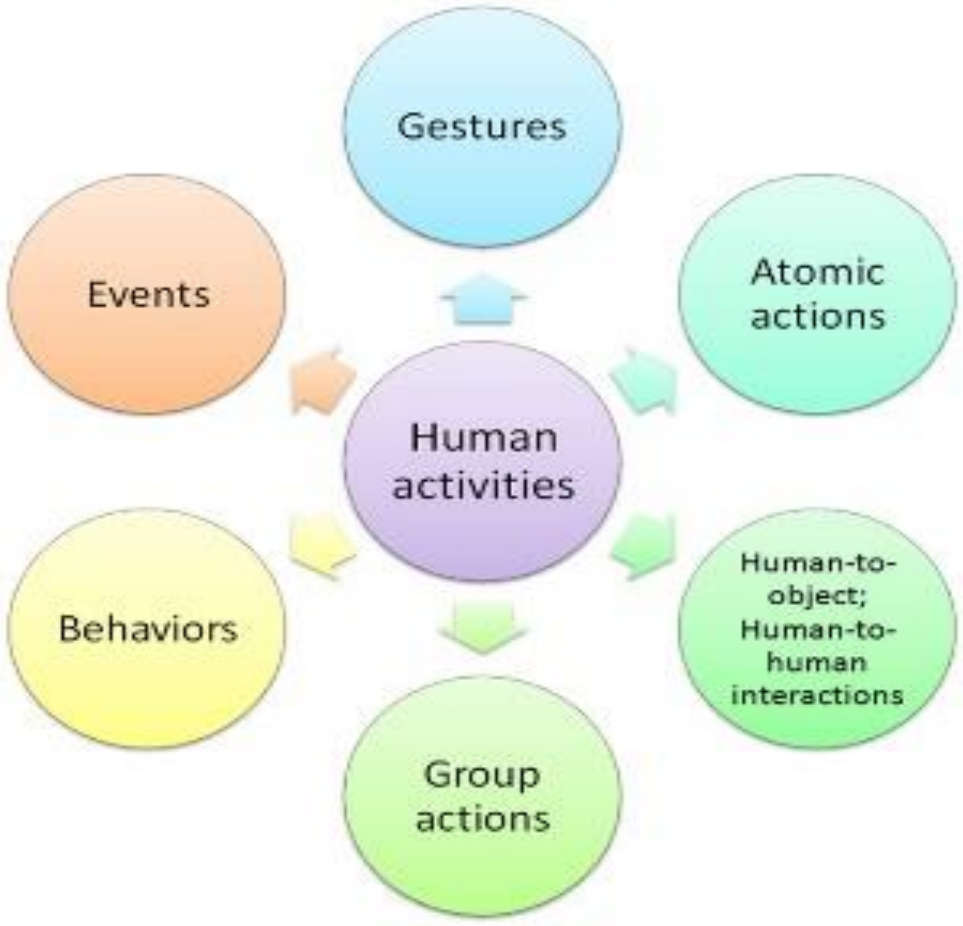
- Human activity recognition plays a significant role in human-to-human interaction and interpersonal relations. The human ability to recognize another person's activities is one of the main subjects of study of the scientific areas of computer vision and machine learning.
- This technology has the potential to be used in automated activity profiling systems which produce a continuous record of activity patterns over extended periods of time.
- It will mainly be used for eldercare and healthcare as an assistive technology when ensemble with other technologies likes Internet of Things (IoT).
- HAR can be done with the help of sensors, smartphones or images. Activity recognition is used in many applications such as surveillance, anti-terrorists, and anti-crime securities as well as life logging and assistance.

Motivation

- Human activity recognition basis for many applications such as video surveillance, health care, and human-computer interaction.
- To Analyse the activity of a person from the information collected by different devices. Discover which are the variables that determine which activity is doing a person.
- To Calculate a predictive model that can recognize a person's activity.

Problem statement

- Human Activity Recognition is the problem of predicting what a person is doing based on a trace of their movement .
- The aim is to build a software that will recognize human activities. We can also predict actions using already recoded videos as well as using live footage.



Objectives

- To identify a method achieving more accurate human activity recognition by using suitable tools and to recommend effective methods for the most cost-effective human activity recognition.
- To propose a mechanism of an automated analysis or interpretation of ongoing events and their context from video data.
- To explore better approach for action recognition based on using the suitable types of data to balance the use of features by strengthen the weak part in each type by the strong part in the other.
- This project will analyze the activity being performed by the user in the Video input. Human activity recognition will use Pose estimation and classification algorithm to analyze the data set and detect the activity

Software and Hardware Requirements

Software Requirement:

- Operating System: Windows 10
- Programming Language:Python
- IDE: VS Code
- Framework: Django

Hardware Requirement:

- Processor: Intel Core I5
- RAM: 8 GB or Higher
- HardDisk: 500 GB

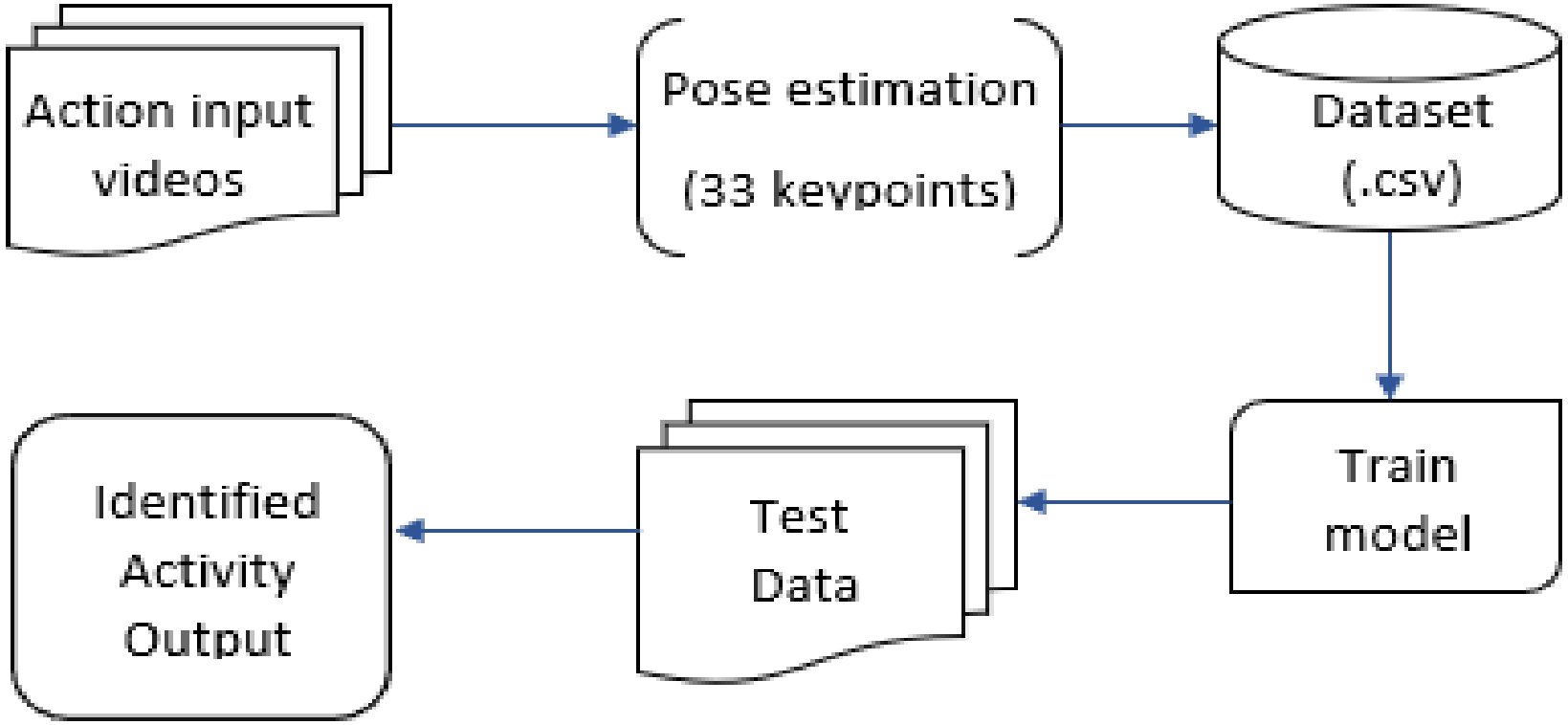
Literature Survey

Sr.no	Title	Author	Abstract
1	Human motion analysis: A review.	Aggarwal and Cai (1999)	Human motion analysis, tracking from single view and multiview cameras, and recognition of human activities.
2	A survey of advances in vision-based human motion capture and analysis	Moeslund et al. (2006)	Mainly focused on pose-based action recognition methods and proposed a fourfold taxonomy, including initialization of human motion, tracking, pose estimation, and recognition methods.

Sr.no	Title	Author	Abstract
3	Deep Convolutional Neural Networks for Human Action Recognition Using Depth Maps and Postures	Aouaidjia Kamel, Bin Sheng, Po Yang, Ping L, Ruimin Shen, David Dagan Feng(2018)	Presented a method (Action-Fusion) for human action recognition from depth maps and posture data using convolutional neural networks (CNNs).
4	Exploiting temporal information for 3D human pose estimation	Mir Rayat Imtiaz Hossain, James J. Little(2018)	Utilize the temporal information across a sequence of 2D joint locations to estimate a sequence of 3D poses. We designed a sequence-to-sequence network composed of layer-normalized LSTM units with shortcut connections connecting the input to the output on the decoder side and imposed temporal smoothness constraint during training.

Sr.no	Title	Author	Abstract
5	Efficient Frequency Domain Feature Extraction Model using EPS and LDA for Human Activity Recognition	Rasel Ahmed Bhuiyan, Nadeem Ahmed (2020)	Enveloped Power Spectrum (EPS) is used for extracting impulse components of the signal, and the Linear Discriminant Analysis (LDA) is used as a dimensionality reduction procedure to extract the discriminant features for human daily activity recognition. After completing EPS feature extraction techniques, LDA is performed on those extracted spectra for extracting features using the dimension reduction technique. Finally, the discriminant vocabulary vector is trained by the Multiclass Support Vector Machine (MCSVM) to classify human activities
6	Human Activity Recognition Using Pose Estimation and Machine Learning Algorithm	Abhay Gupta, Kuldeep Gupta, Kshama Gupta and Kapil Gupta(2021)	A single person poses estimation and activity classification using pose. Pose Estimation consists of the recognition of 18 body key points and joints locations. We have used the OpenPose library for pose estimation work. And the activity classification task is performed by using multiple logistic regression.

Proposed Algorithm

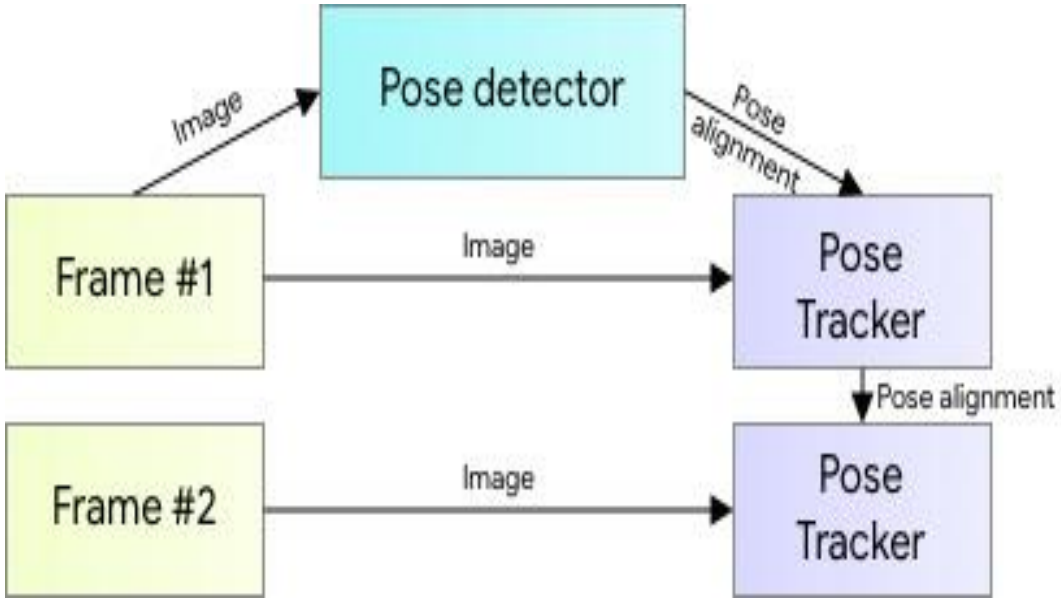


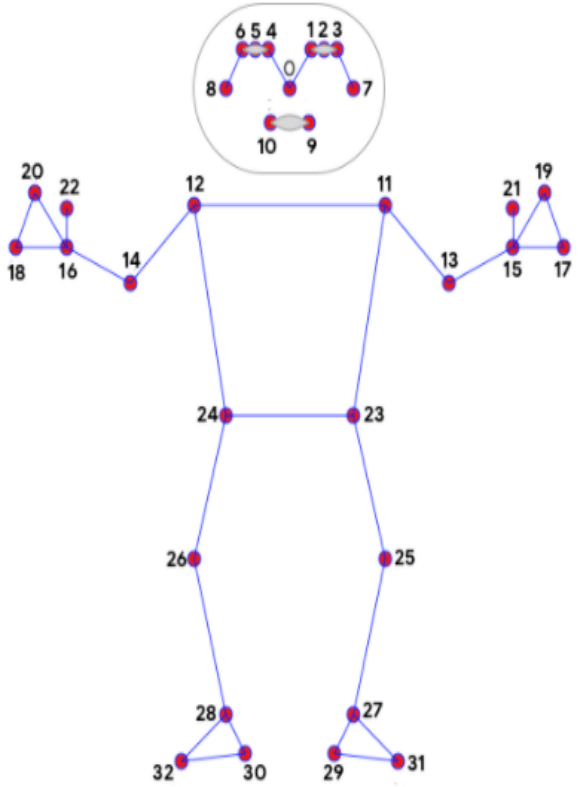
Pose Estimation:

- Pose estimation is a computer vision task that infers the pose of a person or object in an image or video.
- Pose estimation is the problem of determining the position and orientation of a camera relative to a given person or object.
- This is typically done by identifying, locating, and tracking a number of keypoints on a given object or person. For objects, this could be corners or other significant features. And for humans, these keypoints represent major joints like an elbow or knee.

An ML Pipeline for Pose Tracking:

- For pose estimation, we utilize our proven two-step detector-tracker ML pipeline. Using a detector, this pipeline first locates the pose region-of-interest (ROI) within the frame. The tracker subsequently predicts all 33 pose keypoints from this ROI.





0. nose
1. left_eye_inner
2. left_eye
3. left_eye_outer
4. right_eye_inner
5. right_eye
6. right_eye_outer
7. left_ear
8. right_ear
9. mouth_left
10. mouth_right
11. left_shoulder
12. right_shoulder
13. left_elbow
14. right_elbow
15. left_wrist
16. right_wrist
17. left_pinky
18. right_pinky
19. left_index
20. right_index
21. left_thumb
22. right_thumb
23. left_hip
24. right_hip
25. left_knee
26. right_knee
27. left_ankle
28. right_ankle
29. left_heel
30. right_heel
31. left_foot_index
32. right_foot_index

Multinomial Logistic Regression:

- Multinomial logistic regression is used to predict categorical placement in or the probability of category membership on a dependent variable based on multiple independent variables.
- The independent variables can be either dichotomous (i.e., binary) or continuous (i.e., interval or ratio in scale).
- Multinomial logistic regression is a simple extension of binary logistic regression that allows for more than two categories of the dependent or outcome variable.

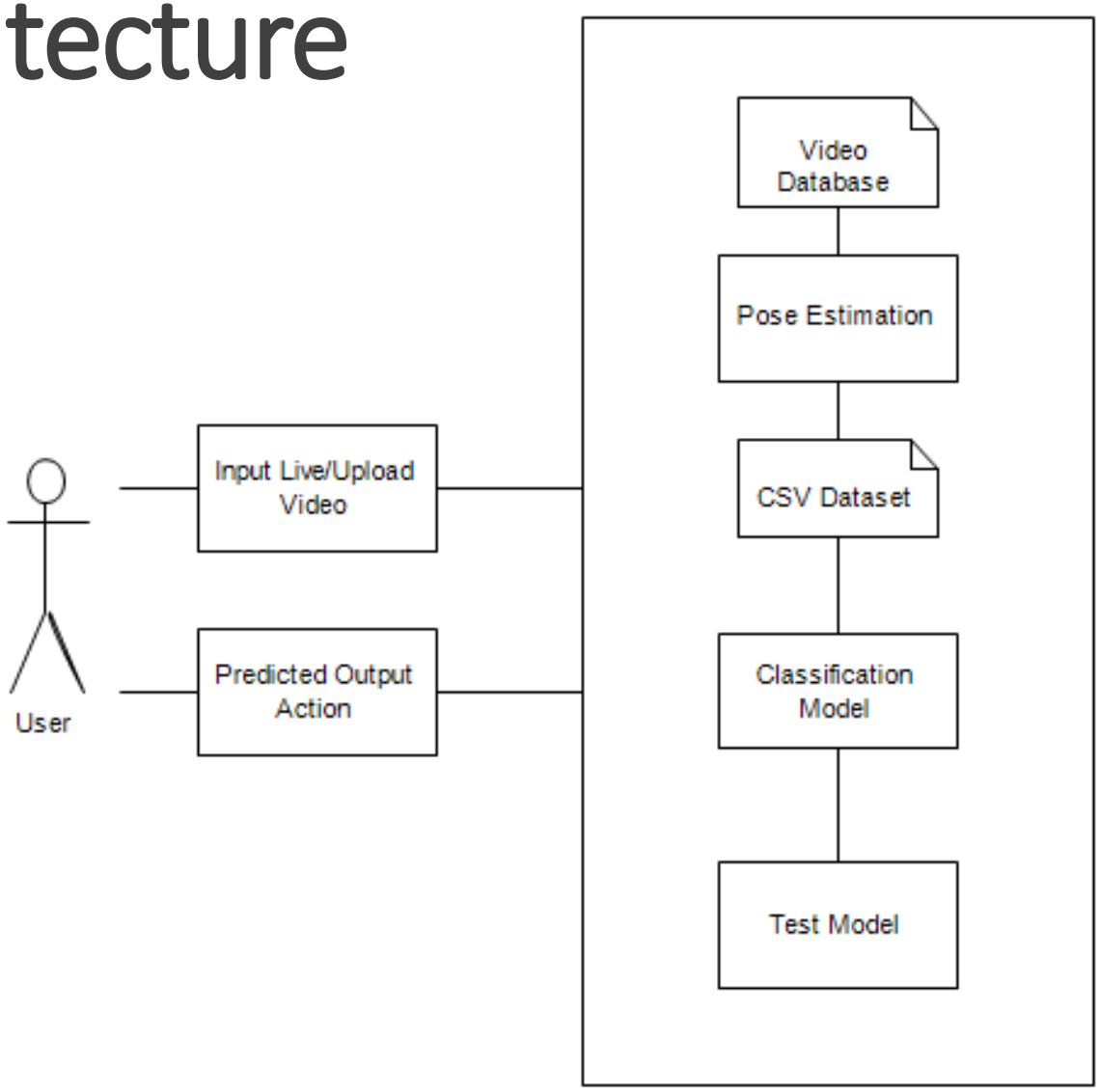
$$\Pr(Y_i = 1) = \frac{e^{\boldsymbol{\beta}_1 \cdot \mathbf{X}_i}}{1 + \sum_{k=1}^{K-1} e^{\boldsymbol{\beta}_k \cdot \mathbf{X}_i}}$$

$$\Pr(Y_i = 2) = \frac{e^{\boldsymbol{\beta}_2 \cdot \mathbf{X}_i}}{1 + \sum_{k=1}^{K-1} e^{\boldsymbol{\beta}_k \cdot \mathbf{X}_i}}$$

$$\cdots\cdots$$

$$\Pr(Y_i = K-1) = \frac{e^{\boldsymbol{\beta}_{K-1} \cdot \mathbf{X}_i}}{1 + \sum_{k=1}^{K-1} e^{\boldsymbol{\beta}_k \cdot \mathbf{X}_i}}$$

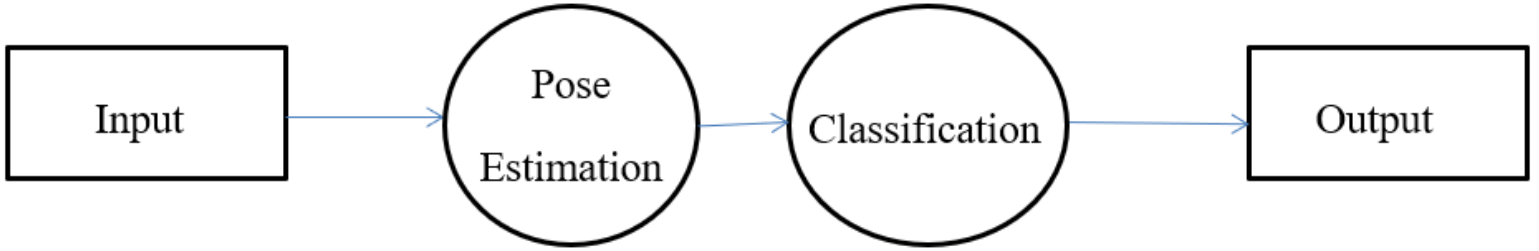
System Architecture



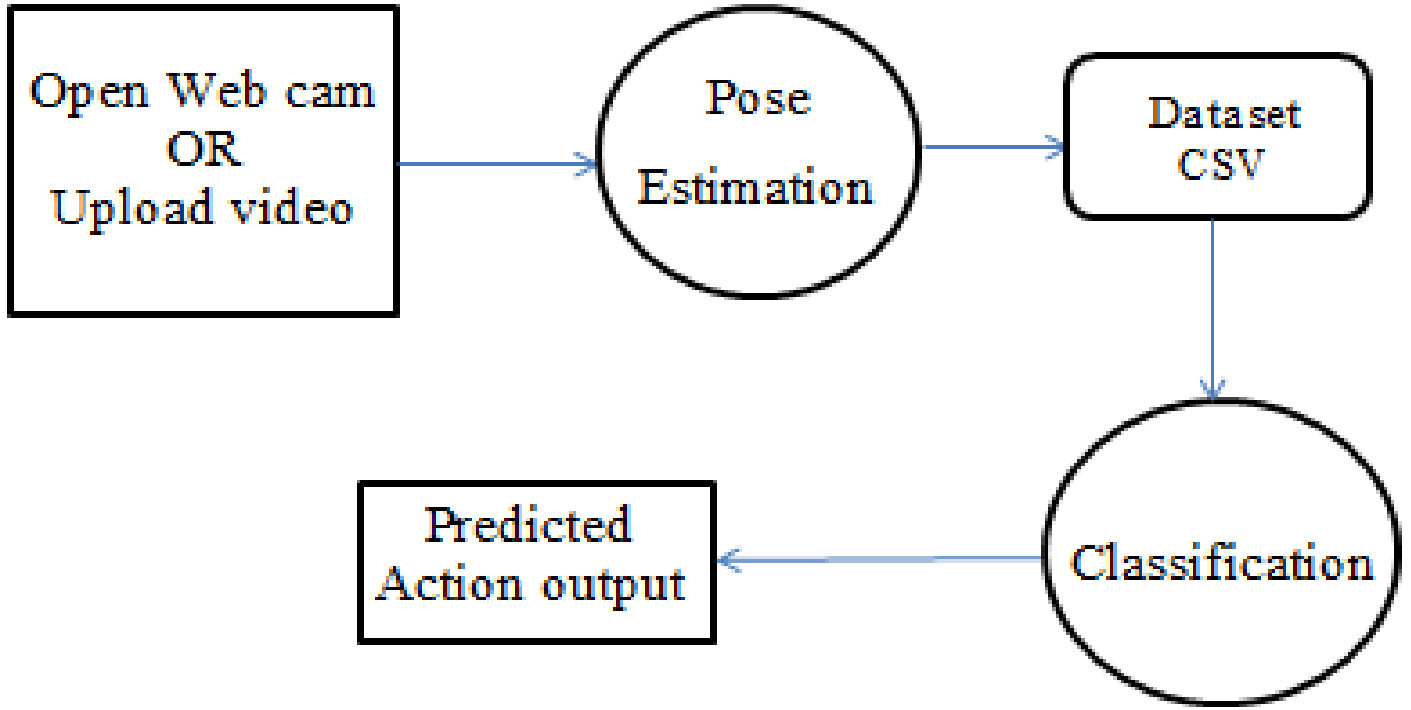
Data Flow Diagram

Level 0 :

Level 1 :

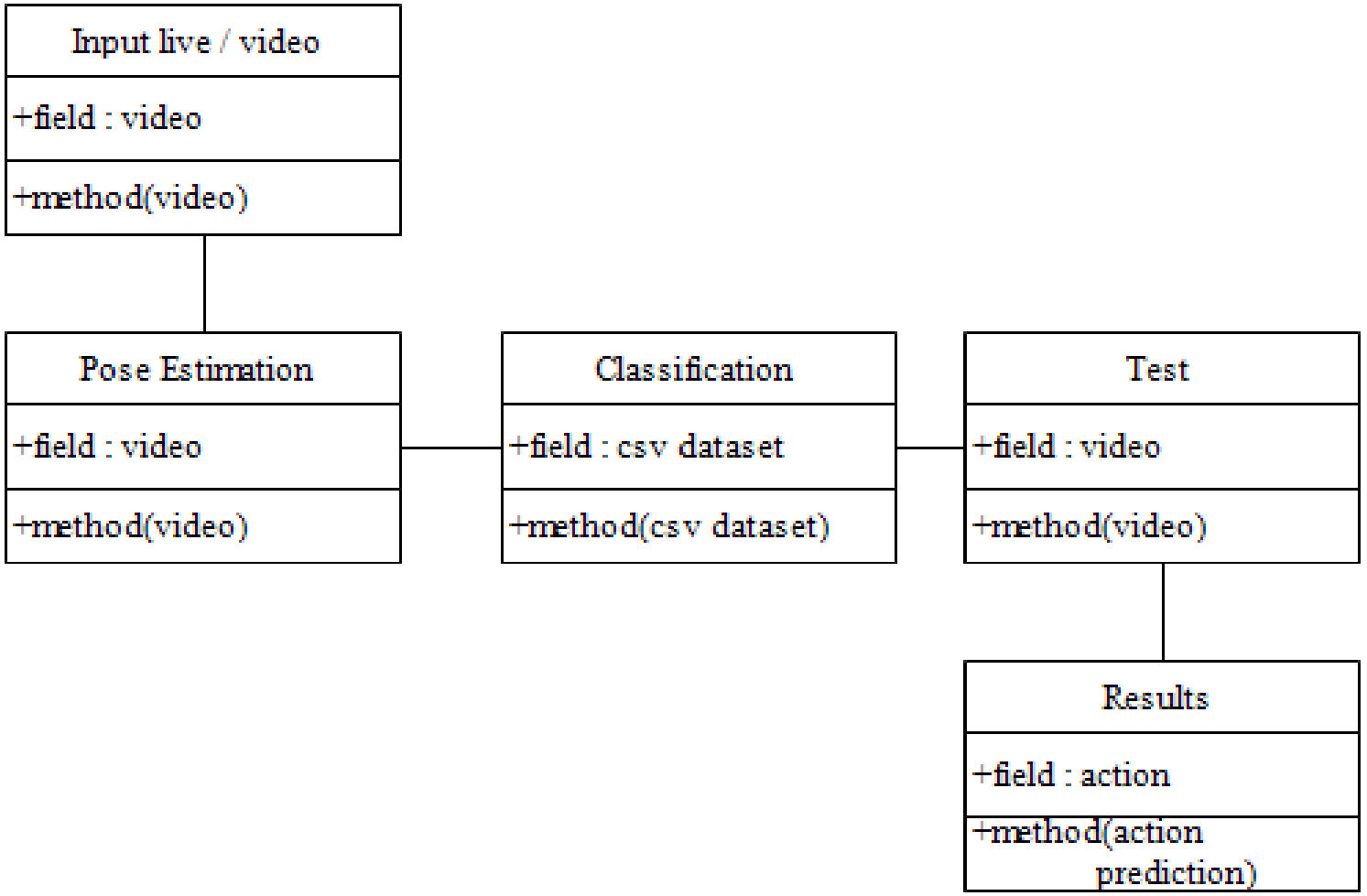


Level 2 :

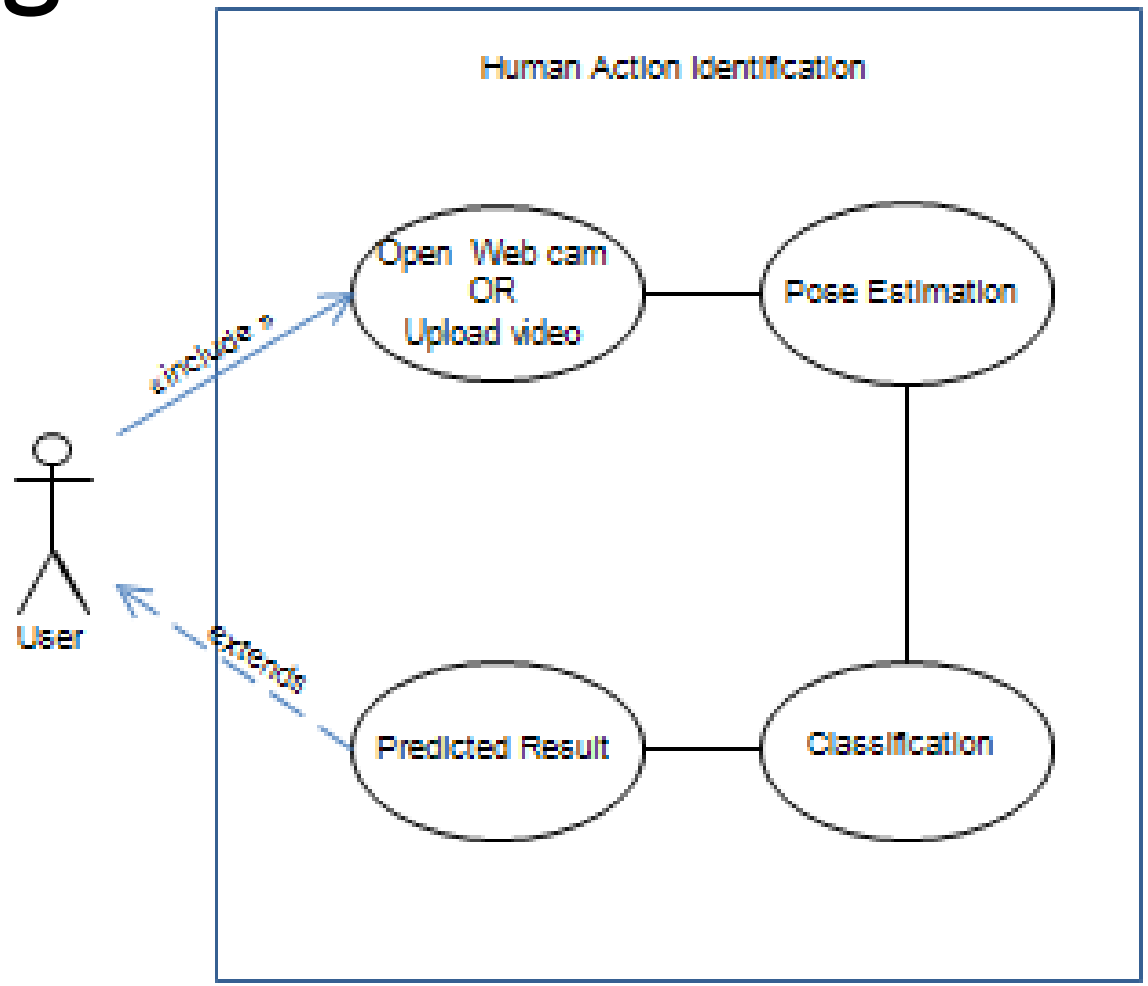

Open Web cam
OR
Upload video
Pose
Estimation
Dataset
CSV
Classification
Predicted
Action output

UML Diagram

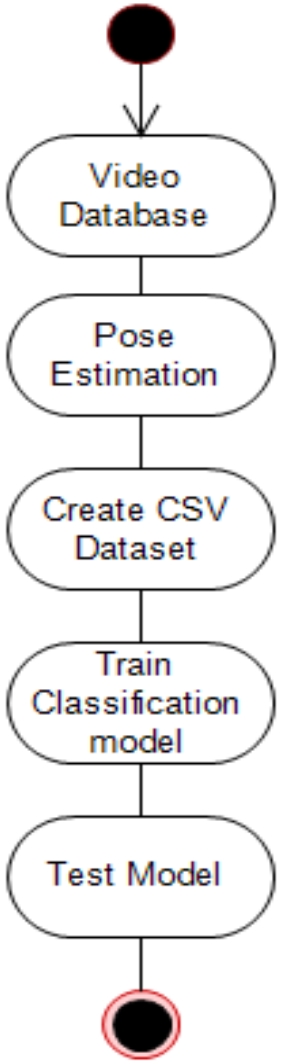
Class diagram :



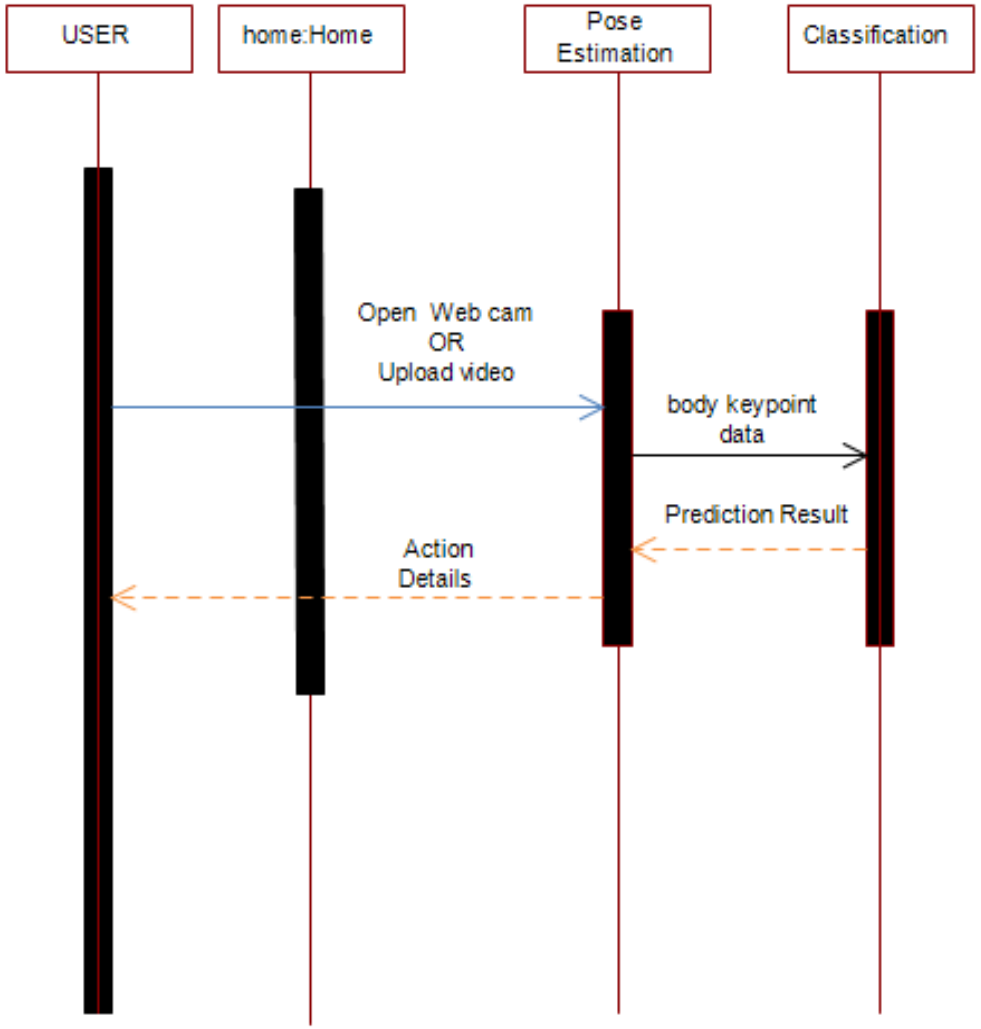
Usecase Diagram



Activity Diagram



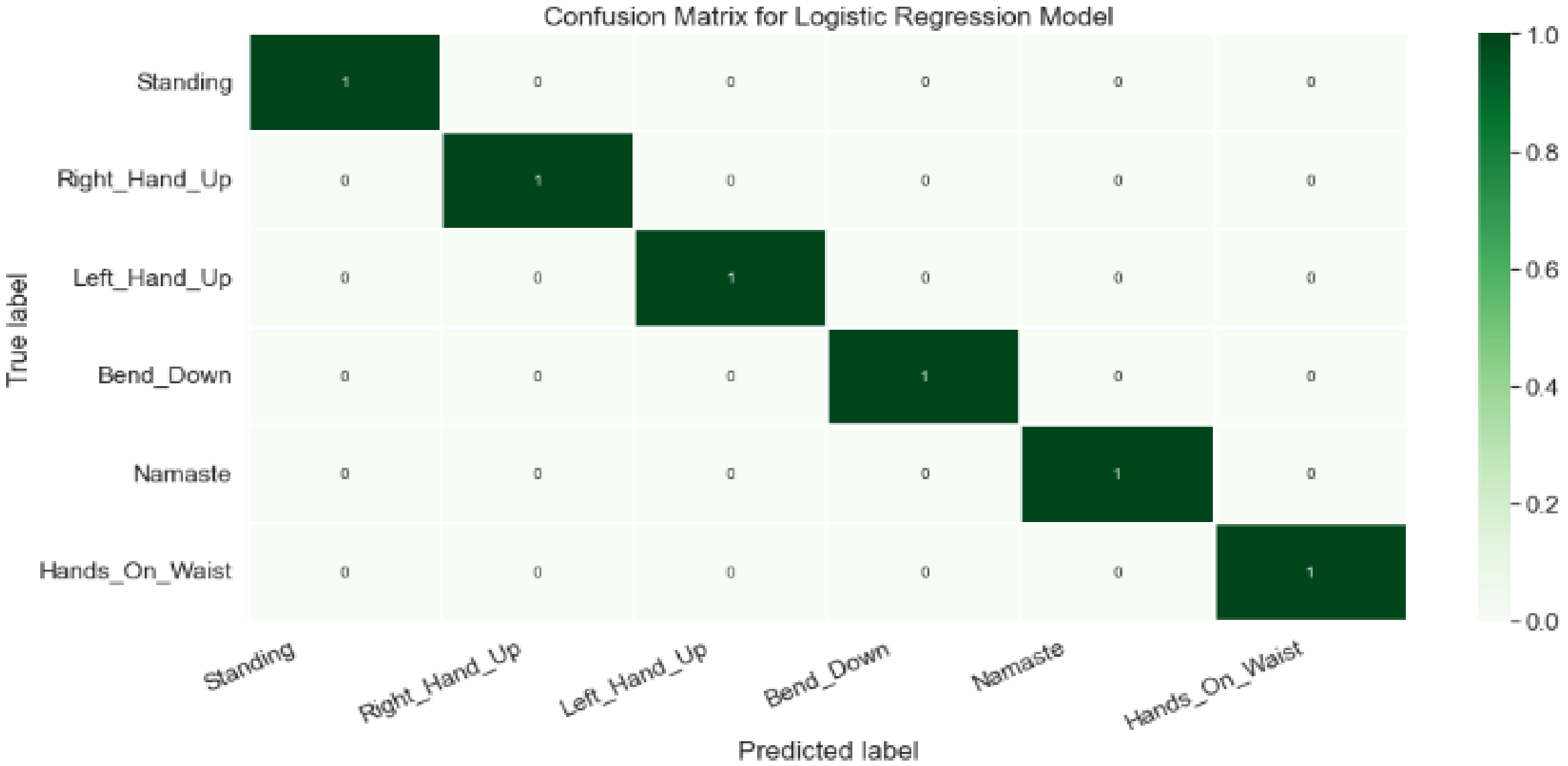
Sequence Diagram

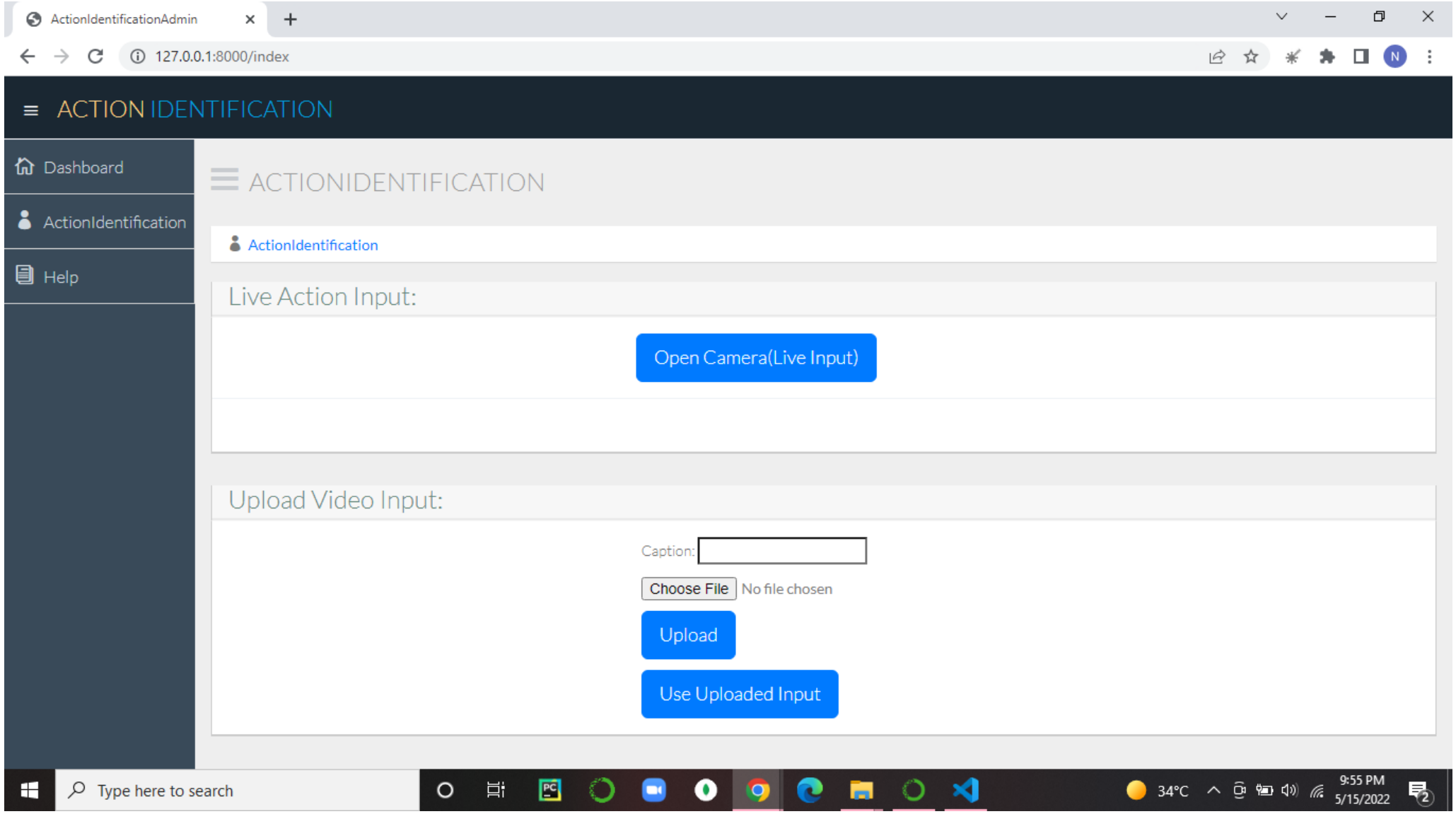


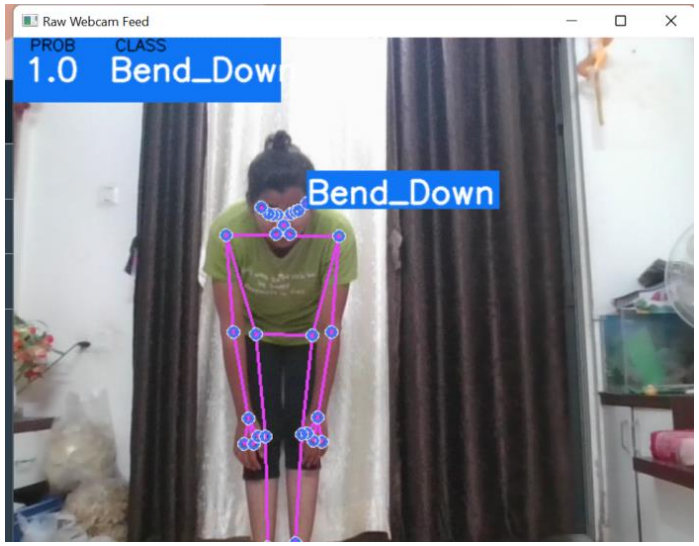
Results & Discussion

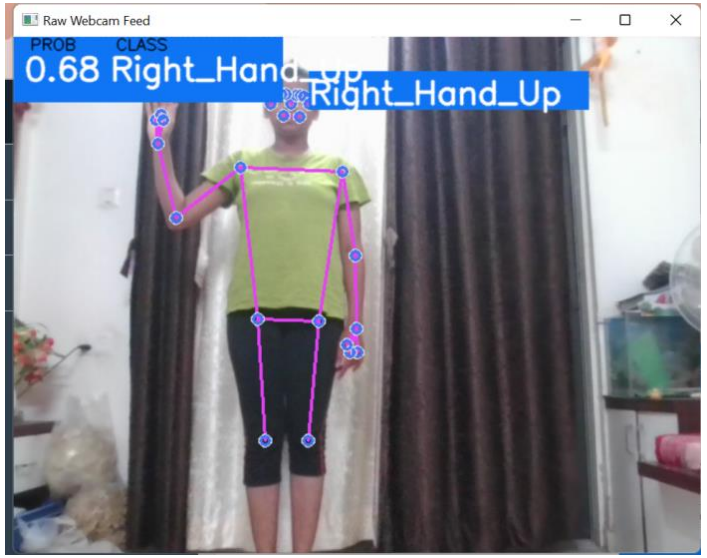
- We have used Logistic regression, ridge classifier, random forest classifier, gradient boosting classifier and got 100% accuracy for Logistic regression, random forest classifier, gradient boosting classifier and 99% for ridge classifier. We used logistic regression as our final model for prediction.

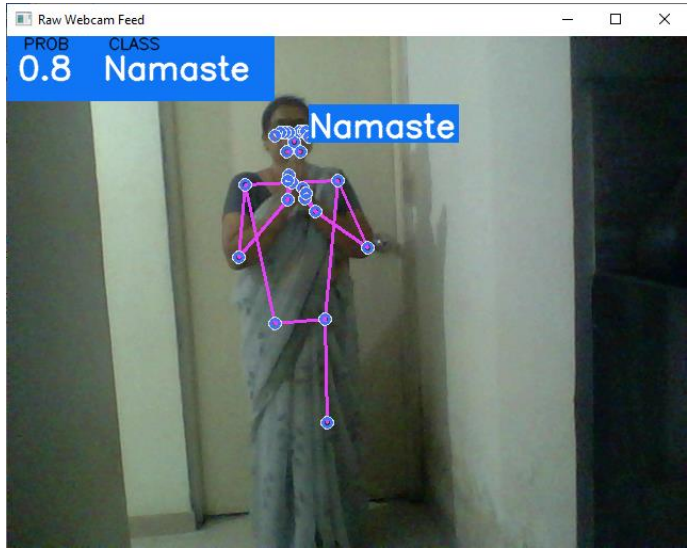
Algorithm	Precision	Recall	F1-Score	Support
Logistic regression	1.0	1.0	1.0	651
Ridge classifier	0.99	0.99	0.99	651
Random forest classifier	1.0	1.0	1.0	651
Gradient boosting classifier	1.0	1.0	1.0	651


Confusion Matrix for Logistic Regression Model
Standing
Right_Hand_Up
Left_Hand_Up
Bend_Down
Namaste
Hands_On_Waist
True label
Predicted label
1.0
0.8
0.6
0.4
0.2
0.0


ActionIdentificationAdmin
127.0.0.1:8000/index
ACTION IDENTIFICATION
Dashboard
ActionIdentification
Help
ACTIONIDENTIFICATION
ActionIdentification
Live Action Input:
Open Camera(Live Input)
Upload Video Input:
Caption:
Choose File
No file chosen
Upload
Use Uploaded Input
Type here to search
34°C
9:55 PM
5/15/2022

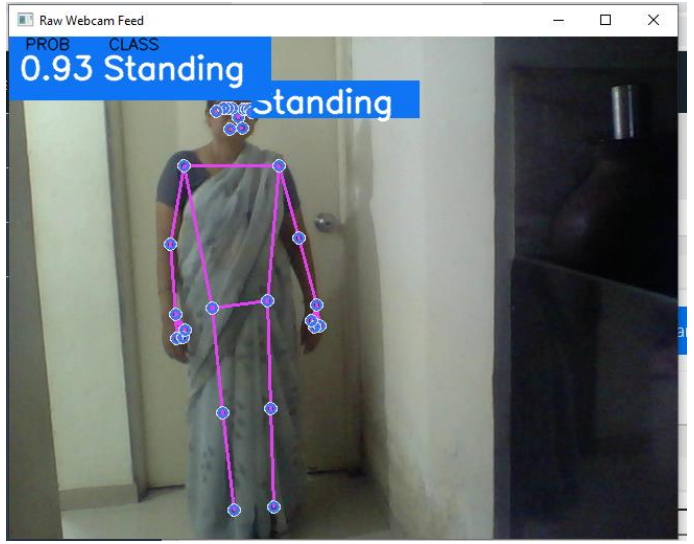

Raw Webcam Feed
PROB
CLASS
1.0
Bend_Down
Bend_Down


Raw Webcam Feed
PROB
CLASS
0.68
Right_Hand_Up
Right_Hand_Up


Raw Webcam Feed
PROB
CLASS
0.8
Namaste
Namaste


Raw Webcam Feed
PROB
CLASS
0.73
Left_Hand_Up
Left_Hand_Up


Raw Webcam Feed
PROB
CLASS
0.4
Hands_On_Waist
Hands_On_Waist


Raw Webcam Feed
PROB
CLASS
0.93
Standing
Standing

Timeline chart:

			PHASE 1						PHASE 2		
ACTIVITY	**START**	**END**	**SEPT**	**OCT**	**NOV**	**DEC**	**JAN**	**FEB**	**MAR**	**APR**	**MAY**
Submission of project ideas.	**1/9/22**	**26/9/22**									
Approval of project idea.	**20/9/22**	**30/9/22**									
Initial Project Work Preparation	**1/10/22**	**25/11/22**									
First presentation about progress of project work(Review1 and Review2)	**2/12/22**	**30/12/22**									
Started Implementation											
Selection of technology Stack	5/1/22	19/1/22									
Pose Estimation Logic	15/1/22	10/3/22									
Front-end Development	25/2/22	6/5/22									
Classification model	3/4/22	25/4/22									
Link Frontend and Backend	10/4/22	15/5/22									
Manual Testing	25/3/22	3/4/22									
Automated Testing	3/5/22	16/5/22									
Review 3											
Presented partial implementation of project	25/3/22	28/3/22									
Review 4											
Presented complete implementation of project	2/5/22	6/5/22									
Submission of report for checking											
Make Revisions in Project report	13/5/22	20/5/22									
Final Submission of Report and Project											
Submitted Black-book Report copy	20/5/22										

Future Scope

- The project that we've implemented is suitable for identifying only single person in the frame. If there is more than one person it can only identify action of one person as shown below.
- In future we're planning to work upon this to identify multiple person activity in a single frame.

Conclusion

- We have proposed a Human Activity Identification system based on pose estimation and classification algorithm.
- This system will combine the results of the 3D pose estimation model with the classification algorithm for better and more accurate detailed result generation.

References

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Thank You!